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Development and the Environment

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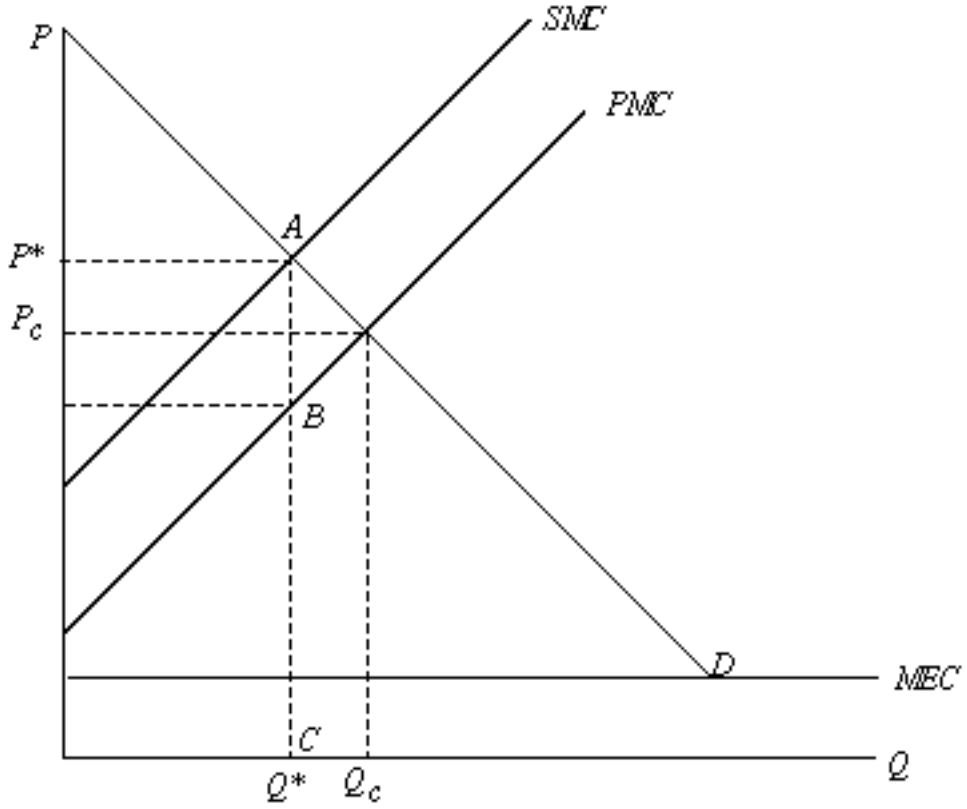
The basic notions behind environmental economics are externalities and market failure.

Externality



D = demand for a good (pesticides) reflecting its positive benefit

SMC = social marginal cost

PMC = private marginal cost

MEC = marginal externality cost

Q^* = optimal quantity

P^* = optimal price

Q_c = competitive quantity

P_c = competitive price.

There is overuse of the good under competition, without intervention. Government intervention is needed to obtain optimality and correct "market failure."

Policies Addressing Externality

(1) Tax on pollution or output: In our case the tax is *AB*. Producer price becomes *BC*.

(2) Direct control: The government sets total output at *Q** and divides use among consumers of the good optimality.

(3) Liability rule: Performance standards are established, and violators of standards are liable for damages.

(4) Transferable permits: Government establishes total output levels at *Q** and establishes production rights that are transferable among producers so they add to *Q**. The price will be *P**. The value of the production permit is *AB*.

Differences Among Policies

Producers of the good like taxation least. They prefer transferable permit because the tax revenues "stay in the industry" and, of course, they love subsidies.

Other Problems

Subsidies may lead to overproduction in the long run (slippage). Direct controls are difficult to implement.

Major Issues of Environmental Policies

(1) Pollution control.

(2) Protection against excessive resource utilization (fisheries, forestry).

This may occur when ownership of these resources is not defined and people consider the harvesting cost--not loss of future benefits--when making harvesting choices.

In both cases there is market failure as private parties fail to consider the impact of activities on a third party.

There are several types of environmental agencies. Some (EPA) protect mostly against pollution by penalizing contamination of air and water, misuse of toxins, etc.

Others (Fish and Wildlife Service) develop policies to conserve natural resources and protect against overuse.

Some conservation activities aim to preserve resources because of their future production potential, and others aim to preserve resources for aesthetic purposes.

Income and Environmental Protection

- Environmental regulation may not exist or may not be enforced, particularly in poor countries. Water-borne diseases are major problems.
- Developing countries with medium levels of income per capita (say, above $2,000/year) address severe pollution problems:

  Air pollution

  Water pollution.
- Protection against overutilization of natural resources occurs mostly in richer countries with GNP/capita of, say, above $5,000/year.
- Rich countries will develop policies to protect resources that provide mainly aesthetic or consumptive benefits.

Economic development leads to increased demand for environmental protection but also increased use of energy and other resources.

Environmental and Human Well-Being

- GNP is a traditional measure of economic well-being of an economy, but it may overestimate economic well-being because it does not consider resource degradation and environmental quality problems.

  A partial answer is introduced by a new measure.

  ANNP -= Adjusted net national product.

  $ANNP = GNP - D_M - D_N$.

  GNP = Gross national product = consumption + saving

  D_M = Depreciation of physical capital

  D_N = Depreciation of neutral capital.

- The correction of a national product will be greater in countries with a high rate of resource depletion (Mexico, Indonesia) than countries with lower rates of depletion (Costa Rica).
- Other measures of well-being explicitly introduce measures of environmental and other aspects of quality of life. It is difficult to monetize environmental benefits or quality of life.
- One approach is to weigh indexes of well-being (life expectancy, air pollution, water quality, population density) by "monetizing" coefficients. However, this approach is arbitrary.

Contingent Valuation

This system uses survey techniques to elicit willingness to pay or accept for environmental quality.

· There is a gap between willingness to pay and accept for environmental amenities resulting from budget constraints. Some environmental amenities may be priceless to people who have them. Therefore, there is a limit to the feasibility of compensation for development. This difference is one obstacle in monetizing.

A second obstacle is the difference between what people say and what they do. A third is the problem of framing. The answer depends on the exact specification of the question. A fourth is an informational problem. Lack of trading and market experience may reduce respondents' capacities to provide quantitative answers.

Solution: "Willingness to vote," especially when the good in question is provided publicly.

Public Goods

Goods with two characteristics:

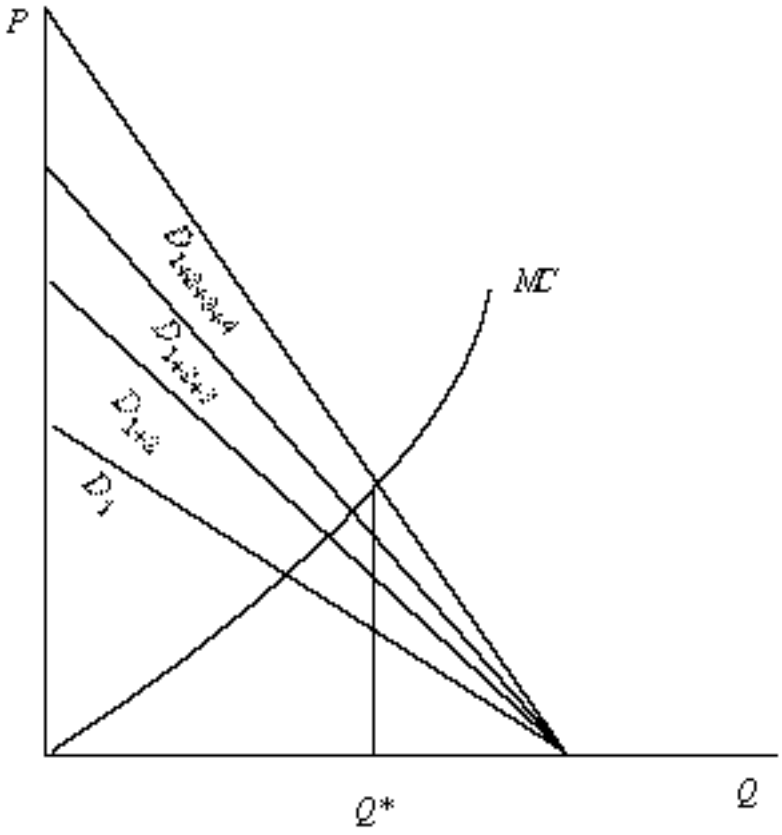
(1) Nonrivalvry in consumption. Many consume them simultaneously.

(2) Nonexcludability. There is no barrier to use.

Example: Air quality

Knowledge

There is market failure in provision of public goods. Let D_1 be demand of one person, D_{1+2} demand of two people, etc.



The optimal quantity is Q^*. At this level, marginal cost is equal to the sum of the marginal benefits of the consumers. No one likes paying for the public good above her/her marginal benefits but all would like to be "free riders."

Because of the public good properties of general knowledge and environmental quality, they cannot be optimally provided by the market forces. Government uses tax revenues to finance public goods.

Research

Defense

Parks

Environmental protection

Roads and infrastructure

Communications (which have some public good properties).

Other providers of public goods:

The church

The rich (they sponsor events and donate to churches and schools)

Foundations

Public goods can be provided by "collective actions," volunteer collaboration of citizens to finance and support projects which benefits they share.

Collective actions result in institutions such as:

(1) Water user associations. They share the cost of conveyance canals and pumps.

(2) Cooperatives. They are established to purchase farm inputs, market farm outputs, and manage jointly owned resources (forests, rangeland). Many

situations, which can be interpreted by the existence of “public good,” may also be the result of production activities that require high fixed costs. Therefore, collective actions in many cases are established to share fixed costs.

- Establishment of organizations for collective action is a political challenge.
- Organizations that control public resources (e.g., waterways) are managed to serve the interest of subgroups.
- Water districts may be controlled by upstream farmers who may underinvest in conveyance to support downstream users.
- Resource managers may earn money from resource sales rather than pursue optimal policies.
- Successful collective action provides a challenge in organization and governance.

Sustainability

A key issue is depletion of natural resources (NR).

- NR can be classified as renewable (fish, forest) or nonrenewable (minerals).
- A continuous extraction of nonrenewable resources will lead to their depletion in the future.
- Renewable resources can be sustained if use does not permanently exceed the growth rate.

For many fisheries, wildlife, or forests, excessive extraction leads to reduction of stock and in some cases to extinction.

Sustainability is aimed to stabilize resource stocks at a socially desirable level. Many development processes may be fueled by excessive extraction--sustainable development aims to combine development and long-run survival.

It, therefore, leads to restoration policies of depleted resource stocks and thus temporary (or permanent) slowness in growth.

It requires monitoring of a natural system to account for natural capital stocks and leads to more ecological, sound management techniques.

Irreversibility: Situations where future effort cannot correct for current or past damage. Death is irreversible.

Uncertainty: Lack of knowledge about the performance of economic and ecological system. Uncertainty requires (1) learning and (2) caution in action.

Adaptive management: Resource utilization approach that entails constant learning and reassessment.

Modern Approach to Projects

- "Feedback" is a key in adaptive management strategies. Actions are taken (new technologies are tried and new incentives are introduced) to observe response which will lend to improving future policies.
- Traditional management policies devise "open loop" systems that are designed to produce the best policies under average future conditions.
- New management techniques (adaptive management) are close loop strategies that experiment identifying states and natures and then make adjustments.

In the past many resource management projects emphasized "structural solution." The best solution to a perceived water shortage was a water diversion project.

Now the emphasis is on nonstructural solution--introduction of an institution or incentive to modify behavior (for example, water markets). While "market failure" may be the cause for many pollution problems, lack of markets and property rights may be the source for other concerns.

- Water is mainly allocated by queues (water rights), and water right holders are not allowed to trade them. Water markets may solve this problem.
- Lack of landownership leads to overgrazing and depletion of land quality. Land rights and trading may reduce this problem.

Technology and the Environment

Perception: Modern technology is a major cause of environmental degradation:

Pesticides

Fertilizers

Reality: Technology impacts depend on policy. Technologies have had strong, positive environmental effects.

(1) Higher yields prevented the need to expand land bases, thus, further reducing wildland and damaging biodiversity.

(2) Knowledge and technology are useful for:

Detecting environmental problems

Restortation

Incentives may lead to pollution and contamination.

Conservation Technologies

· In many technologies it is useful to distinguish between applied input and effective input (input used by crops).

· In some cases input use efficiency is 50%; thus, 50% of input ends up as runoff or leakage.

These leakages may be sources of environmental problems. For example:

• Water logging (rising ground water level).

• Ground water contamination of chemicals.

• Surface water contamination by runoff water.

• Aerial drift.

Conservation technology reduces residues.

· Aerial spraying of pesticides has 75% drift; when precise application is used, drift may be reduced to 2%**.**

· Drip irrigation may have 95% irrigation efficiency, sprinkler has 85% efficiency, and gravitational technology has 60% efficiency.

Adoption of modern conservation technologies may:

-Save input

-Increase yield

-Reduce residues.

However, they require extra capital and labor cost.

Conservation technologies are not optimal everywhere. They are more valuable in (1) environments where traditional technology has low input use efficiency and (2) when economic and environmental conditions give them an extra edge.

- Sprinklers and drip irrigation are more valuable in locations with sandy soils or steep hills and when water prices and output prices are high.
- Precise pesticide application is valuable in windy areas with high value crops and expensive chemicals.

Lack of incentives may prevent adoption of conservation technologies. Their adoption will be enhanced by

- A tax on drainage .
- Investment subsidies.
- Elimination of water or pesticide subsidies.
- Introduction of trading rights for water and pollution.

Adoption of such technologies may be an important sustainable strategy.

There needs to be ongoing research on further development of conservation and precision technologies.

Such technologies have been designed to take into account specific conditions of LDCs, cheap unskilled labor, and expensive capital cost.

The availability of technologies does not assure adoption. This requires extra incentives and effective institutions (environmental agencies, extension, input dealers).

Global Environmental Problems

-Climate change

-Acid rain

-Biodiversity

-Ozone depletion

-Fish stock depletion

- Global resource problems are in most cases a bigger concern for developed nations.
- There is a need for cooperation.
- Developed countries demand to be paid to cooperate.
- Schemes like “debt for nature” require monitoring and enforcement to be effective.
- A major issue is protection for the hardest-hit victims of problems (Bangladesh in case of global warming).
- Solutions to global problems erode the power of states and lead to the emergence of powerful international institutions.